

# **Climate Change and Ecosystem Response in Suisun bay, San Francisco Bay Estuary, and upstream**

**Frances P malamud**

# Final Selection Panel Review

## Proposal Title

#0232: Climate Change and Ecosystem Response in Suisun bay, San Francisco Bay Estuary, and upstream

## Funding:

Do not fund

In their clarifying comments, the PIs expressed concern that the proposal had only been read by two reviewers who rated it very differently. Although the two technical reviewers gave it different ratings, their main concern was the same: the proposal lacked a clear statement of how a model will be produced from the historical data that will explore hydrologic and ecological consequences of future climate change scenarios. That is the concern behind the one reviewer's concern with data reduction. How will the paleoclimatic record being generated be translated into a product that can be used to evaluate future climate scenarios. Furthermore, this proposal had four, not two, reviewers. In addition to the two outside technical reviewers, two technical synthesis panel members read and evaluated the proposal. Their comments and the panel discussion are summarized in the Technical Synthesis Panel review. The main problem raised in the panel review was also the lack of connection between the paleoclimate reconstruction and its application to evaluating future climate scenarios: the linkage between reconstructing past climates and predicting the consequences of future climates is not adequately demonstrated in this proposal. Hence all reviewers had basically the same message. Furthermore, the concern about impacts of bioturbation on the cores that was raised by reviewers and panel was not addressed in the clarifying comments. Given the very limited budget for Calfed science, and the emphasis on direct relevance to Calfed issues

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## Final Selection Panel Review

in the Final Selection Panel, it is highly unlikely that this proposal would have been recommended for funding even if the Technical Synthesis Panel had rated it higher.

## **Public Comments**

The following public comments were received for this proposal.

proposal # 232 Rekd Adequate by ISP

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JUN 13 2005

June 13, 2005

DEPARTMENT OF GEOGRAPHY  
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Dear Dr. Lougee,

Thank you for reviewing our submission to the CALFED Science Program and for providing us an opportunity for clarifying comments as part of the review process. We have attached clarifying responses to the comments by both Reviewers that we felt could be addressed.

We were surprised by how widely the two reviews of our proposal differed in both comments and ratings. Reviewer #2 gave the proposal excellent and very good ratings throughout and the comments indicated a good understanding of the proposed research and of the potential value of the records that would result from our research. We also thought that this Reviewer gave useful suggestions for improving our proposal. Reviewer #1, on the other hand, gave mostly very low ratings ("fair"). Some comments were difficult to understand and thus to address. For example, the reviewer commented that "data reduction and management are not discussed anywhere in the proposal". This is puzzling, as page 16 of our proposal was devoted to data reduction. The header on that page reads "Data reduction analyses".

While we realize that there were many proposals submitted to this CALFED Science PSP and that not all could receive more than two reviews, we wonder in this situation, with two such divergent reviews, whether the process may have benefited from a third reviewer.

We appreciate the added efforts of the Selection Panel in reviewing our clarifications.

Regards,

A handwritten signature in blue ink, appearing to read 'Lynn Ingram'.

B. Lynn Ingram

Professor

Departments of Geography and Earth & Planetary Sciences

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Berkeley, CA 94720

A handwritten signature in blue ink, appearing to read 'Frances Malamud-Roam'.

Frances Malamud-Roam

Postdoctoral Fellow

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#0232 Climate Change and Ecosystem Response in Suisun bay, San Francisco Bay Estuary, and upstream

P.I.: Prof. B.L. Ingram

June 10, 2005

Clarifying Comments

This proposal was read by only two reviewers, who gave widely differing reviews, but who both felt that some clarification was necessary on two main points addressed below. Reviewer #2 was strongly in favor of this proposed research (giving mostly high ratings of “excellent” and “very good”) and wrote that with minor clarification, our overall rating to be raised to “excellent”. The other reviewer gave lower ratings of “fair” (please see letter to Program Manager).

Both reviewers requested clarification of how the parameters of our study will be integrated to yield predictive models. In short, we propose to combine data on paleo-environmental conditions in the San Francisco Estuary (in particular, Bay salinity and regional precipitation patterns) with data on the geomorphic and ecological responses of tidal marshes fringing this estuary in order 1) to determine responses of estuary edge landforms and associated ecosystems to natural climate variability in the past, which 2) can serve as a model for marsh ecosystem responses to future climate change. Tidal marshes are the chosen model sites because they provide essential habitat for many important taxa; they respond relatively rapidly to changes in climate and river flow, and their sediments preserve records of past conditions and responses.

Previous studies of California’s climate history, including lake level studies (Stine, 1990, 1994), tree ring studies (e.g. Hughes and Brown, 1992), pollen studies (e.g., Anderson and Smith, 1992), and stable isotopes (e.g. Benson, et al. 2002) have shown considerable climatic variability over the past 2,000 to 4,000 years. Moreover, Bay salinity records also indicate variability (Ingram et al. 1996 a,b; Ingram and DePaolo, 1993), with adjacent tidal marsh landforms and ecosystems responding in consistent ways (Goman and Wells, 2000; Byrne et al. 2001; Malamud-Roam and Ingram, 2004): specifically 1) the surface elevation responds to sediment supply, and 2) the plant assemblages respond to local salinity, shifting between a relatively uniform cover of salt tolerant species and a more diverse mix of less salt-tolerant species. The Bay estuary watershed is comprised of two principle river systems, the Sacramento, draining the northern part of the watershed and delivering the majority of fresh water inflow, especially during the winter months, and the San Joaquin, draining the southern portion of the watershed, and providing fresh water during the summer months from melting snow in the higher elevations (Dettinger and Cayan, 2003). An important question remains: do the estuary marshes respond more sensitively to climate changes over the northern versus the southern half of the large watershed region? 1,200-year tree-ring reconstructions of the two rivers reveal that climate change does not always impact both of these river systems in the same way: there have been extended periods in the past when one basin received abnormally low precipitation while the other basin received normal, or even above normal precipitation (Meko et al., 2002). We propose to analyze in detail the changing patterns of Bay

salinity, sedimentation (both rate and provenance) and vegetation of a sensitive brackish marsh (Suisun marsh), to provide a basis for understanding how climate change can impact tidal marsh ecosystems in the Bay. This information will be directly relevant for policy makers and scientists who need to make decisions about marsh restoration and protection.

Our approach includes detailed analyses of the stable oxygen content of fossil shells from Bay archaeological middens (for salinity patterns); elemental concentrations and isotopes ratios of silts and clays from of several marsh surface cores (for changing ratios of sediment input from the two river systems), and pollen and stable carbon isotopes of these marsh cores (for vegetation changes). These techniques have demonstrated success (see Ingram and Lin, 2002; Ingram et al., 1996 a,b; Malamud-Roam and Ingram, 2004; Malamud-Roam et al. 2004; Byrne et al. 2001). Using this approach, we propose producing a model of how past climate variability has impacted Bay salinity, sedimentation rates and vegetation assemblages in the surrounding tidal marshes. This model will allow us to apply scenarios of predicted changes in climate patterns (e.g., Dettinger, 2005; Knowles and Cayan, 2002) and predict how sensitive tidal marshes may respond, especially marshes which may be more sensitive to changes in sedimentation and salinity.

We also included a habitat study of certain target species of estuary fish, which one of the reviewers felt did not clearly fit in with the rest of the proposal. We agree that this part of the proposal is not critical to our overall research plan and could be removed from this proposal to be pursued elsewhere as a separate study, which would benefit from the results of our current proposed work.

Both reviewers also requested clarification of the budget. Reviewer #1 specifically said that the budget was *not* unreasonable, but that it needed more justification. We requested funding for two full-time postdoctoral researchers. We feel this level of staffing is essential to the success of this project. Multiple proxy records from multiple cores are required to get a representative description of conditions in the marsh as a whole (that is, we wish to avoid potential confounders of localized effects) both in terms of vegetation patterns and sedimentation patterns and multiple fossil shells obtained from central Bay shell mounds must be analyzed for the salinity record.

Finally, we would like to reduce our budget by \$40,000 to reflect a recent grant awarded to one of the P.I.s for one aspect of this research.

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# Technical Synthesis Panel Review

## Proposal Title

#0232: Climate Change and Ecosystem Response in Suisun bay, San Francisco Bay Estuary, and upstream

Final Panel Rating
adequate

## Technical Synthesis Panel (Primary) Review

### TSP Primary Reviewer's Evaluation Summary And Rating:

The proposed study is a paleo-ecological reconstruction of climate variability in Bay-Delta. While based on sound methodology and good science, it is unclear the relevance to CALFED, the proposers' assertion that knowledge of past climate changes is critical to assessing forecasts and adaptive management, notwithstanding.

### Additional Comments:

The primary objective of this study is to predict what future climate changes might occur in the watershed of the San Francisco area and what their possible impacts on local ecosystems might be. However, nowhere in the proposal is there an indication on how this goal will be achieved. The project description lacks clarity and focus, as indicated, for example, by the inclusion of a fish comparative sampling study that appears to be only marginally related to the main project goals. It is not clear how the proposed approach will lead to meeting the primary objective of the study. Although the methods applied are described in painstaking detail, data reduction and management are not discussed in the proposal. The study proposes to develop detailed geochronologies of the sediment column in the Suisun Bay area marshes of San

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## Technical Synthesis Panel Review

Francisco Bay (in the vicinity of the Sacramento-San Joaquin Delta) based on  $^{14}\text{C}$  and  $^{210}\text{Pb}$ . Subsequently, the combination of pollen analyses, isotope analyses (C, O and Sr), elemental analyses, grain size and particulate organic analyses will be used to assess changes in salinity and tidal marsh vegetation over the last ~4 k ybp. In addition, the sources of sediments to the tidal marshes and the delta area will be inferred. From these assessments, the relationships between climate variations and resultant freshwater inflow and salinity of the system will be assessed. The use of proxies such as pollen, isotopes, elemental analyses, etc. in carefully dated sediment cores to assess paleoenvironments in coastal systems and infer past climatic conditions has gained validity over the last decade. However, finding and verifying undisturbed sediment columns that lack gaps in the records or mixing by physical or biological agents is difficult. The proposal does not explain potential problems with breaks in the core or compaction. I assume the authors have dealt successfully with this issue, but since it is critical it needs to be verified. No mention is made in the proposal as to how problems such as bioturbation in the cores will be dealt with (or if it is a problem). And finally, identifying and verifying proxies to determine environmental parameters over time is difficult.

The proposed study is a paleo-ecological reconstruction of climate variability in Bay-Delta. While based on sound methodology and good science, it is unclear the relevance to CALFED, the proposers' assertion that knowledge of past climate changes is critical to assessing forecasts and adaptive management, notwithstanding.

## Technical Synthesis Panel (Discussion) Review

### TSP Observations, Findings And Recommendations:

The primary stated objective of this study is to predict potential future climate conditions in the CBDA project-area. The applicants propose to use a paleo-ecological approach to reconstruct past climate conditions. The disconnect between the stated goals and the proposed approach is a major

## Technical Synthesis Panel Review

stumbling-block for this proposal - a paleo-reconstruction of past climates may well be a valuable product but it will not allow prediction of future climates.

The proposed paleo-ecological approach, methodology and measures are well-developed and described. The methodologies are standard and their strengths and weaknesses are well-known. It is likely to produce valuable reconstruction of climates (and resulting hydrology) over the last four thousand years in the CBDA project area.

The fish sampling aspect of the proposal is only marginally connected to the goals and products identified elsewhere in the proposal. The intended use of these data and their perceived value are not clearly described and are difficult to understand in the context of this proposal.

Rating: Adequate

# Technical Review #1

proposal title: Climate Change and Ecosystem Response in Suisun bay, San Francisco Bay Estuary, and upstream

## Review Form

### Goals

Are the goals, objectives and hypotheses clearly stated and internally consistent? Is the idea timely and important?

Comments	The primary objective of this study is to predict what future climate changes might occur in the watershed of the San Francisco area and what their possible impacts on local ecosystems might be. However, nowhere in the proposal is there any indication on how this goal will be achieved. This study would provide very valuable information regarding past changes in the region but how will these data be used to, in the PI's words, "prepare extrapolations to probable future scenarios"? The project description lacks clarity and focus, as indicated for example by the inclusion of a fish comparative sampling study that appears to be only marginally related to the main project goals.
Rating	fair

### Justification

Is the study justified relative to existing knowledge? Is a conceptual model clearly stated in the proposal and does it explain the underlying basis for the proposed work? Is the selection of research, pilot or demonstration project, or a full-scale implementation project justified?

Comments	see above
Rating	fair

## Technical Review #1

### Approach

Is the approach well designed and appropriate for meeting the objectives of the project? Is the approach feasible? Are results likely to add to the base of knowledge? Is the project likely to generate novel information, methodology, or approaches? Will the information ultimately be useful to decision makers?

<b>Comments</b>	It is not clear how the proposed approach will lead to meeting the primary objective of the study. Although the methods applied are described in painstaking detail, data reduction and management are not discussed anywhere in the proposal.
<b>Rating</b>	fair

### Feasibility

Is the approach fully documented and technically feasible? What is the likelihood of success? Is the scale of the project consistent with the objectives and within the grasp of authors?

<b>Comments</b>	Likelihood of success hard to judge.
<b>Rating</b>	fair

### Monitoring

If applicable, is monitoring appropriately designed (pre–post comparisons; treatment–control comparisons)? Are there plans to interpret monitoring data or otherwise develop information?

<b>Comments</b>	not applicable
<b>Rating</b>	not applicable

### Products

Are products of value likely from the project? Are contributions to larger data management systems relevant and considered? Are interpretive (or interpretable) outcomes likely from the project?

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## Technical Review #1

<b>Comments</b>	Papers...
<b>Rating</b>	fair

### Additional Comments

<b>Comments</b>
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### Capabilities

What is the track record of authors in terms of past performance? Is the project team qualified to efficiently and effectively implement the proposed project? Do they have available the infrastructure and other aspects of support necessary to accomplish the project?

<b>Comments</b>	The PIs are very well qualified and I was thus very surprised by the low quality of the proposal.
<b>Rating</b>	very good

### Budget

Is the budget reasonable and adequate for the work proposed?

<b>Comments</b>	This project appears very expensive and a significant part of the expenses is for salaries. Cut \$43K for the fish population study. It is not relevant to the proposed project.
<b>Rating</b>	fair

### Overall

Provide a brief explanation of your summary rating.

<b>Comments</b>	Considering its cost, the proposed project should have been more clearly presented and justified. A lot is promised here, but due to the lack of detail and relevant discussion, I am unable to tell if the PIs' goals are attainable or not using the proposed approach.
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Technical Review #1

	A small, less costly pilot project might be more appropriate.
Rating	fair

# Technical Review #2

proposal title: Climate Change and Ecosystem Response in Suisun bay, San Francisco Bay Estuary, and upstream

## Review Form

### Goals

Are the goals, objectives and hypotheses clearly stated and internally consistent? Is the idea timely and important?

Comments	<p>This study proposes to develop detailed geochronologies of the sediment column in the Suisun Bay area marshes of San Francisco Bay (in the vicinity of the Sacramento-San Joaquin Delta) based on <math>^{14}\text{C}</math> and <math>^{210}\text{Pb}</math>. Subsequently, the combination of pollen analyses, isotope analyses (C, O and Sr), elemental analyses, grain size and particulate organic analyses will be used to assess changes in salinity and tidal marsh vegetation over the last ~4 k ybp. In addition, the sources of sediments to the tidal marshes and the delta area will be inferred. From these assessments, the relationships between climate variations and resultant freshwater inflow and salinity of the system will be assessed. The goals, objectives, and hypotheses presented in the proposal are clear enough so that the purpose, the approach, and the relationships being assessed are clear and consistent.</p> <p>The use of proxies such as pollen, isotopes, elemental analyses, etc. in carefully dated sediment cores to assess paleoenvironments in coastal systems and infer past climatic conditions has gained validity over the last decade. Assessing past climates and trends is crucial to understanding potential future changes and timing in climatic conditions. However, finding and verifying undisturbed sediment columns that lack gaps in the records or mixing by physical or biological agents is difficult. In addition, determining accurate</p>
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## Technical Review #2

	<p>and reproducible geochronologies is difficult. And finally, identifying and verifying proxies to determine environmental parameters over time is difficulty. And all of these things have to be done well to apply results to assessing climate change. Therefore, it is a complex, multifaceted scientific question. Although we have made major progress over the last decade in conducting these types of studies, a great deal of further work needs to be done. However, if we are to interpret the past with more resolution and apply these results to predicting the future, then studies such as the one presented here are needed. Therefore, the study is timely and important.</p>
Rating	excellent

## Justification

Is the study justified relative to existing knowledge? Is a conceptual model clearly stated in the proposal and does it explain the underlying basis for the proposed work? Is the selection of research, pilot or demonstration project, or a full-scale implementation project justified?

Comments	<p>I agree with the investigators of this proposal that in order to develop predictive capabilities for future climate change we need to develop the ability to determine climatic conditions and trends from the past - beyond the time scale of historic records. Previous studies have shown that tidal marshes often contain a continuous sedimentary record of their own development and events that occur in the watersheds. The problem is the level of resolution that can be obtained and identifying and calibrating proxies for key environmental parameters. The proposed study appears to build on what is known about determining tidal marsh geochronologies. In addition, the group of investigators has experience in developing and using proxies to assess environmental variables such as salinity and vegetation. Based on their publication record it also appears their techniques have to a large degree been successful. Also, based on the</p>
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## Technical Review #2

	referencing in the proposal, the investigators are aware of most of the pertinent literature. Based on the aforementioned criteria, I believe the proposed research is justified.
Rating	excellent

## Approach

Is the approach well designed and appropriate for meeting the objectives of the project? Is the approach feasible? Are results likely to add to the base of knowledge? Is the project likely to generate novel information, methodology, or approaches? Will the information ultimately be useful to decision makers?

Comments	The approach to the proposed research project is for the most part reasonable and doable, although there are some key questions that need to be addressed. For instance, the use of carefully obtained tidal marsh cores to decipher the temporal history of events and conditions in the watershed is well grounded. However, the proposal does not explain potential problems with breaks in the core or compaction. I assume the authors have dealt successfully with this issue, but since it is critical it needs to be verified. Furthermore, the analyses being conducted for determining sediment column geochronologies and used for proxies seem reasonable and will likely be successful. For instance, $^{14}\text{C}$ and $^{210}\text{Pb}$ are proven techniques for assessing sediment age. However, no mention is made in the proposal as to how problems such as bioturbation in the cores will be dealt with (or if it is a problem). Mixing of sediments by organisms or physical processes can cause difficulty with $^{210}\text{Pb}$ profiles. Similarly, transport of organic matter for $^{14}\text{C}$ analyses can cause problems. How these issues will be addressed needs some explanation (brief). More importantly, the proposal indicates how each of the parameters that are being measured such as pollen and C isotopes will yield information on vegetation in the marshes and surrounding watersheds through time, how C and O isotopes will indicate paleosalinities, or how
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## Technical Review #2

	<p>elemental analyses and Sr isotopes will yield information on provenance. In addition, how all of these will be sampled and how they can be used for proxies is presented. However, what seems missing to me is how all this information will be tied together to indicate past climates, changes in climate, and how much can be determined about climatic conditions from the proxies measured. Some of this information is given within the proposal, but I think a specific section or figures concerning how the measured environmental parameters will help hindcast climate conditions is needed. This is a major point of the proposal. I also understand that this proposal is partly to develop the approaches to the problem, but this would be very helpful.</p> <p>After addressing the issues identified above, I believe the approach to the proposed research is feasible and will meet the objectives of the project. In addition, the rating would increase from very good to excellent. The results gained will both further our ability to study and our understanding of Holocene paleoenvironmental conditions. I believe this will be useful to managers.</p>
Rating	very good

## Feasibility

Is the approach fully documented and technically feasible? What is the likelihood of success?  
Is the scale of the project consistent with the objectives and within the grasp of authors?

Comments	<p>The approaches being used to address the questions being addressed in this proposal are feasible and the investigators are capable of conducting the research (based on their publication records). The project is difficult, but the approach is consistent with how past environments are being assessed and how they are related to climatic conditions.</p>
Rating	

## Technical Review #2

	<b>very good</b>
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### Monitoring

If applicable, is monitoring appropriately designed (pre–post comparisons; treatment–control comparisons)? Are there plans to interpret monitoring data or otherwise develop information?

<b>Comments</b>	<b>Not Applicable</b>
<b>Rating</b>	<b>not applicable</b>

### Products

Are products of value likely from the project? Are contributions to larger data management systems relevant and considered? Are interpretive (or interpretable) outcomes likely from the project?

<b>Comments</b>	<b>The authors indicate the results of the proposed work will be published in scientific journals. Based on the CVs within the proposal it appears the authors have a good history of publishing their work. In addition, the PIs will give workshops and make the knowledge gained available via web publications. These outlets seem reasonable.</b>
<b>Rating</b>	<b>very good</b>

### Additional Comments

<b>Comments</b>	<b>None.</b>
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### Capabilities

What is the track record of authors in terms of past performance? Is the project team qualified to efficiently and effectively implement the proposed project? Do they have available the infrastructure and other aspects of support necessary to accomplish the project?

<b>Comments</b>	<b>As previously pointed out, based on the references presented, the CVs, and the discussions in the</b>
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## Technical Review #2

	proposal the authors seem very well qualified and experienced in the type of proposed research. Their publications records are good. The institutions supporting the work appear very well equipped and will provide the necessary support to conduct the research.
Rating	excellent

## Budget

Is the budget reasonable and adequate for the work proposed?

Comments	It is hard to evaluate the entire budget and the needs and costs that will be incurred. The research is complex and expensive without doubt. However, for the number of cores indicated the total budget seems somewhat high. I do not disagree that the costs are reasonable, but I think the budget needs more justification.
Rating	not applicable

## Overall

Provide a brief explanation of your summary rating.

Comments	In general, I think the questions being addressed are very important, I think the methods being used to address the issues are state-of-the-art, and I think the investigators are highly qualified. The major problem I have with the proposal is the omission of a clear statement concerning how a model will be produced to predict future scenarios of hydrologic impacts of climate change as well as ecological responses from the results of this study. It is scattered throughout the proposal, but a clear description of how the parameters will be interrelated and how it will yield predictive models is needed. Once this issue is clarified the the overall rating
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Technical Review #2

	would increase from good to excellent.
Rating	very good

